CLAIMS

SUB B1

1. Method for performing registration of optical holograms on an amorphous molecular semiconductor (AMS) film deposited on a glass substrate which is pre-covered with an electric conducting sub-layer, where the formation of a hologram comprises charging the surface of the AMS-film by a corona discharge, creating a latent electrostatic image of the hologram of the object on the surface of the AMS-film, developing the latent electrostatic image into a geometrical relief at the surface of the AMS-film, restricting the development of the geometric relief by a pre-set value of the diffraction efficiency of the restored holographic image, resetting the AMS-film for new registrations, and restricting the erasing process by a pre-set value of the diffraction efficiency, c h a r a c t e r i s e d i n that it comprises:
   - charging the surface of the AMS-film at an maximum allowable corona discharge current that the AMS-film can withstand before the film surface becomes destroyed by the positive ion bombardment, and continuing the charging up to the highest achievable potential before local breakdowns begin to occur, in order to achieve the maximum signal to noise ratio in the restored holographic image and to increase the number of operation cycles the AMS-film can withstand without loss of quality in the hologram recordings,
   - reducing the electron and hole components of the dark conductivity of the AMS-film by pulse heating the film when it has reached the operating surface potential, in order to increase the resolution and holographic sensitivity of the AMS-film,
   - initiating the heating of the AMS-film for developing the electrostatic image into a geometrical relief at the optimal start temperature and heating the AMS-film at an optimal heating rate, in order to additionally increase the resolution and holographic sensitivity of the AMS-film up to the optimum reproducible levels, and
   - illuminating the AMS-film by a flash lamp simultaneously with the heating of the film during the erasing process such that bulk and surface charges of the film is removed, in order to increase the number of recording cycles the film can withstand before the film's holographic sensitivity is reduced to a level at which the film must be replaced, and in order to reduce the erasing time and temperature.

2. Method according to claim 1,
c h a r a c t e r i s e d i n that when the method is to be applied for double exposure holographic interferometry, the development of the latent electrostatic image of the first exposure comprises to convert the latent electrostatic image

into a latent image, a so-called photo-electret image, by pulse heating the AMS-film by applying a pulsating electric current on the electric conducting sub-layer and by subsequently illuminating the AMS-film by a flash-lamp followed by recharging the surface of the AMS-film up to it's initial operating surface potential.

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3. Method according to claim 1~~ or 2,~~
characterised in that the AMS-film consists of 92 wt% of a copolymer comprising N-epoxypropylcarbazole and 5 wt% buthylglycedil ether, doped with 5 wt% of methyl-9-(4-dodecyl-oxyphenyl-1,3-selenathiol-2-ylidene)-2,5,7-trinitrofluorene-4-carboxylate and 4 wt% of hexadecyl-2,7-dinitro-dicyanomethylenfluorene-4-carboxylate.

4. Method according to claim 3,
characterised in that the starting temperature of the heating of the AMS-film during development of the electrostatic image is preferably within the range from 15 to 40°C, and that the optimal starting temperature is 36°C.

5. Method according to claim 4,
characterised in that the heating rate of the AMS-film during development of the electrostatic image is preferably in the order of 10^6 °C/sec.

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6. Method according to claim 3 ~~or 4,~~
characterised in that the when temperature of the AMS-film is within the range from 15 to 40°C, the optimum charging potential of the film surface is 125 V/μm and the maximum charging current is 1 μA/cm², respectively.

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7. Method according to a~~ny of the preceding~~ claim~~s,~~ 1
characterised in that the diffraction efficiency is measured in the zeroth diffraction order.

8. Method according to claim 7,
characterised in that the heating of the AMS-film during development of the latent electrostatic image or photo-electret image of a hologram into a geometrical relief at the film surface, is terminated when the measured diffraction efficiency reaches a pre-set value in the range of 0.005-30% or if the time derivative of the measured diffraction efficiency reaches a termination condition.

9. Method according to claim 8,
characterised in that
- when the electrostatic image is developed into a photo-electret image, the pulse pre-heating of the AMS-film is terminated when the measured diffraction

efficiency of the restored holographic image reaches a pre-set value of 0.05%, and

- when the geometrical relief at the film surface, which corresponds to the developed image of the hologram, becomes erased in order to reset the AMS-film, the heating of the AMS-film is terminated when the measured diffraction efficiency of the restored holographic image reaches a pre-set value of 0.01%.

10. Method according to claim 8 ~~or 9~~

c h a r a c t e r i s e d i n that the termination condition is either that the calculated time derivative of the measured diffraction efficiency changes sign from a positive to a negative value or if the absolute value of the time derivative of the measured diffraction efficiency becomes less than a threshold value which is close to zero.

11. Method according to claim 9,

c h a r a c t e r i s e d i n that the photo-electret image has a lifetime of up to 20 hours.

12. Method according to claim 9,

c h a r a c t e r i s e d i n that the AMS-film achieves a holographic sensitivity of up to 1650 m^2/J, a resolution of up to 1700 mm^{-1} and a signal-to-noise ration of up to 125.

13.Device for performing registration of optical holograms on an AMS-film, comprising

- a source of coherent light,
- an optical device for hologram formation,
- a registering medium comprising an AMS-film deposited on a glass substrate which is pre-coated with an electric conducting and transparent sub-layer,
- an electric circuit for charging the AMS-film by a corona discharge comprising a high voltage source, a corona electrode, an electronic charging time-relay and an electromechanical shatter,
- an electric circuit for measuring and restricting the temperature of the AMS-film comprising a temperature sensor, a comparator and a key-commutator,
- an exposure time-relay,
- a development voltage supply,
- a development time-relay, and
- an opto-electric circuit for restriction of the development process as given by the pre-set value of the diffraction efficiency comprising a photo-sensor, an erasing time-relay, and an opto-electronic circuit for the erasing process control,

c h a r a c t e r i s e d i n that it comprises;

- an electric circuit for setting the optimal start temperature of the AMS-film

where the output of the circuit is connected to the input of the charging time-relay, and which contains a voltage source that is connected via the start temperature key-commutator to the conducting sub-layer of the registering medium, and an indicator which displays when the registering medium has reached the optimal start temperature,

- an electric circuit for controlling the charging of the surface of the AMS-film comprising a corona discharge current measuring unit connected between the high voltage supply and electrically conducting transparent sub-layer of the registering medium, and a surface potential measuring unit containing an electrostatic probe located above the surface of the AMS-film and which is connected to the input of the surface potential comparator, and where the output of the comparator is connected to the input of the charging time-relay, and
- an electric circuit for the reduction of the electron and hole components of the dark conductivity of the AMS-film, that additionally comprises a pulse preliminary electronic heating time-relay which is connected to an output of the electronic charging time-relay, to an input of the development/erasing key-commutator, to an input of the recharging time-relay, and to a dark electro-conductivity comparator connected between the surface potential measuring unit and the pulse preliminary electronic heating time-relay, where the recharging time-relay is connected to an output of the pulse preliminary time-relay, and to an input of the exposure time-relay, the high voltage supplier and recharging comparator, and where the recharging comparator is connected between the surface potential measuring unit and recharging time-relay.

14.Device according to claim 12,
characterised in that the device additionally comprises a flash lamp and a flash lamp switching unit, the input of which is connected to the input of the erasing time-relay.

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15.Device according to claim~~s~~ 12~~-13~~,
characterised in that an opto-electric circuit for the development/erasing restriction by the pre-set value of the diffraction efficiency as measured in the zero diffraction order is incorporated into the device, by including an unit for separating and measuring the variable component of the reference beam light intensity and an unit for measuring and memorising the reference beam intensity at the initial moment of time of development and erasing, mutually connected in parallel, and where the input of which is connected to the photo-sensor output installed in the zeroth diffraction order, and its output is connected to the input of the diffraction efficiency calculating unit, and the diffraction efficiency calculating unit, the output of which is connected to the inputs of the development/erasing comparators, and where the outputs of the

development/erasing comparators are connected to the inputs of the time-relays of development and erasing process, respectively;

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16. Device according to claim~~s~~ 12~~-14~~, characterised in that for the case when one cannot estimate in advance the value of the limiting diffraction efficiency and/or it is impossible to reach the pre-set value of the diffraction efficiency, an opto-electric scheme for restricting the development process when reaching a pre-set value of the time derivative of the diffraction efficiency is incorporated into the device, by including
- an unit for separating and measuring the variable component of the reference beam light intensity,
- an unit for measuring and memorising the reference beam intensity at the initial moment of time of the development process which is connected in parallel with the unit for separating and measuring the variable component of the reference beam light intensity, and where the inputs of these units are connected to the output of the photo-sensor located in the zeroth diffraction order, and their outputs are connected to a diffraction efficiency calculating unit,
- a diffraction efficiency calculating unit, where the output is connected to a differentiator,
- a differentiator, where the output is connected to the input of a comparator of the differentiator, and
- a comparator of the differentiator where the input is connected to the output of the development time-relay.

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17. Device according to claim~~s~~ 12~~-15~~, characterised in that the device contains;
- an opto-electric circuit for latent photo-electret formation comprising a photo-electret state formation time-relay where the input is connected to the output of the exposure time-relay and the output is connected to the input of the development/erasing key-commutator, a flash lamp with a flash lamp switching unit which is connected to the output of the electronic latent photo-electret image formation time-relay and the flash lamp, and
- an opto-electric circuit for restricting the conversion of the latent electrostatic image into the latent photo-electret image comprising an unit for separating and measuring the variable component of the light intensity of the reference beam which is connected between the output of the photo-sensor which is installed in the zeroth diffraction order and input of the diffraction efficiency calculation unit, and an unit for measuring the intensity of the reference beam and memorising at the initial time, which is connected in parallel with the unit for separating and measuring the variable component of the light intensity of the reference beam, and a pulse heating comparator where the input is connected to

the output of the diffraction efficiency calculating unit and the output is connected to the input of the electronic photo-electret image formation time-relay.

Add B2

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